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SCIENTIFIC COMMUNICATION: UNDERSTANDING SCIENTIFIC JOURNALS AND ARTICLES

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Scientists make their research available to the community by publishing it in scientific journals. In scientific papers scientists explain the research that they are building on, their research methods, data and data analysis techniques, and their interpretation of the data Understanding how to read scientific papers is a critical skill for scientists and students of science. Present Paper attempts to highlights the role of science communication for understanding scientific articles and journals in changing context of modern society.

Keywords: Information, Communication, Science Communication, Scientific Journals, Scientific Articles, Communicators

Science Communication: Meaning

Science communication generally refers to public media presenting science-related topics to non-scientists. This often involves professional scientists (called 'outreach' or 'popularization'), but has evolved into a professional field in its own right. It includes science exhibitions, science journalism, and science policy and science media production. Science communication can be important, not just to maintain a demand for ongoing science, but because some information is directly applicable. Science can also inform political and ethical thinking. There is an increasing emphasis on teaching the methods, and not just the authoritative findings of science. These issues may be especially critical in the face of scientific misinformation, and how much easier it is to spread .Communicators can use all the same methods of entertainment and persuasion as in other professions, including humor, storytelling, and metaphors. Scientists are sometimes even trained in some of the techniques used by actors .Science communication can also simply describe

communication between scientists (e.g. through scientific journals) as well as between non-scientists.

Scientific Journals

A scientific journal is a periodical publication intended to further the progress of science usually by reporting new research There are thousands of scientific journals in publication, and many more have been published at various points in the past .Most journals are highly specialized, although some of the oldest journals such as Nature publish articles and scientific papers across a wide range of scientific fields. Scientific journals contain articles that have been peer reviewed in an attempt to ensure that articles meet the journal's standards of quality, and scientific validity Although scientific journals are superficially similar to professional magazines they are actually quite different. Issues of a scientific journal are rarely read casually, as one would read a magazine. The publication of the results of research is an essential part of the scientific method If they are describing experiments or calculations, they must supply enough details that an independent researcher could repeat the experiment or calculation to verify the results. Each such journal article becomes part of the permanent scientific record. A periodical that serves as a source of scientific information and means of scientific communication. This category includes bulletins and serial publications—collections of articles and reports of scientific institutions and public conferences, such as Transactions and Proceedings. There are three types of scientific journals. Primary journals publish for the most part new findings or new interpretations and discussions of known facts and ideas. Secondary journals mainly provide data on primary documents and are the product of information and bibliographical activities. They include journals of abstracts and indexes to them, alert information, express information bulletins, and bibliographical journals. The third, or tertiary, type of scientific journal generalizes previously published source material. This includes survey journals, journals dealing with scientific methodology, and certain popular science or general science journals. There are thousands of scientific journals that publish research articles. These journals are diverse and can be distinguished according to their field of specialization. Among the most broadly targeted and competitive are journals like *Cell*, the **New England Journal of Medicine(NEJM**), **Nature,** and **Science** that all publish a wide variety of research articles.*Cell* focuses on all areas of biology, NEJM on medicine, and both *Science*and *Nature* publish articles in all areas of science. Scientists submit manuscripts for publication in these journals when they feel their work deserves the broadest possible audience.Just below these journals in terms of their reach are the top-tier disciplinary journals like *Analytical Chemistry, Applied Geochemistry, Neuron, Journal of Geophysical Research*, and many others. These journals tend to publish broad-based research focused on specific disciplines, such as chemistry, geology, neurology, nuclear physics, etc. Next in line are highly specialized journals, such as the *American Journal of Potato Research, Grass and Forage Science, the Journal of Shellfish Research, Neuropeptides, Paleolimnology*, and many more.

The History of Scientific Journals

The history of scientific journals dates from 1665, when the French **Journal des sçavans** and the English **Philosophical Transactions of the Royal Society** first began systematically publishing research results. Over a thousand, mostly ephemeral were founded in the 18th century, and the number has increased rapidly after that.Articles in scientific journals can be used in research and higher education. Some classes are partially devoted to the explication of classic articles, and

seminar classes can consist of the presentation by each student of a classic or current paper. In a scientific research group or academic department it is usual for the content of current scientific journals to be discussed in journal clubs.The standards that a journal uses to determine publication can vary widely. Some journals, such as **Nature Science PNAS**, and **Physical Review Letters** have a reputation of publishing articles that mark a fundamental breakthrough in their respective fields. In many fields, an informal hierarchy of scientific journals exists; the most prestigious journal in a field tends to be the most selective in terms of the articles it will select for publication, and will also have the highest impact factor It is also common for journals to have a regional focus, specializing in publishing papers from a particular country or other geographic region, like **African Invertebrates**. Articles tend to be highly technical, representing the latest theoretical research and experimental results in the field of science covered by the journal. They are often incomprehensible to anyone except for researchers in the field and advanced students. In some subjects this is inevitable given the nature of the content. Usually, rigorous rules of scientific writing are enforced by the editors; however, these rules may vary from journal to journal, especially between journals from different publishers.

Types

There are several types of journal articles; the exact terminology and definitions vary by field and specific journal, but often include:

- **Letters** (also called *communications*, and not to be confused with *letters to the editor*) are short descriptions of important current research findings that are usually fast-tracked for immediate publication because they are considered urgent.
- **Research notes** are short descriptions of current research findings that are considered less urgent or important than *Letters*.
- **Articles** are usually between five and twenty pages and are complete descriptions of current original research findings, but there are considerable variations between scientific fields and journals – 80-page articles are not rare in mathematics or theoretical computer science
- **Supplemental articles** contain a large volume of tabular data that is the result of current research and may be dozens or hundreds of pages with mostly numerical data. Some journals now only publish this data electronically on the internet.
- **Review articles** do not cover original research but rather accumulate the results of many different *articles* on a particular topic into a coherent narrative about the state of the art in that field. Review articles provide information about the topic and also provide journal references to the original research. Reviews may be entirely narrative, or may provide quantitative summary estimates resulting from the application of meta-analytical methods

The format of journal articles

In June of 2005, the journal *Science* published a research report on a sighting of the ivory-billed woodpecker, a bird long considered extinct in North America (**Fitzpatrick et al., 2005**). The work was of such significance and broad interest that it was displayed prominently on the cover and highlighted by an editorial at the front of the journal (**Kennedy, 2005)**. The authors were aware that their findings were likely to be controversial, and they worked especially hard to

make their writing clear. Although the article has no headings within the text, it can easily be divided into sections:

Title and authors:

The title of a scientific article should concisely and accurately summarize the research. While it is meant to capture attention, journals avoid using misleading or overly sensational titles the names of all scientific contributors are listed as authors immediately after the title. You may be used to seeing one or maybe two authors for a book or newspaper article, but this article has seventeen authors! It's unlikely that all seventeen of those authors sat down in a room and wrote the manuscript together. Instead, the authorship reflects the distribution of the workload and responsibility for the research, in addition to the writing. By convention, the scientist who performed most of the work described in the article is listed first, and it is likely that the first author did most of the writing. Other authors had different contributions; for example, Gene Sparling is the person who originally spotted the bird in Arkansas and was subsequently contacted by the scientists at the Cornell Laboratory of Ornithology. In some cases, but not in the woodpecker article, the last author listed is the senior research on the project, or the scientist from whose lab the project originated. Increasingly, journals are requesting that authors detail their exact contributions to the research and writing associated with a particular study.

Abstract

The abstract is the first part of the article that appears right after the listing of authors in an article. In it, the authors briefly describe the research question, the general methods, and the major findings and implications of the work. Providing a summary like this at the beginning of an article serves two purposes: first, it gives readers a way to decide whether the article in question discusses research that interests them, and second, it is entered into literature databases as a means of providing more information to people doing scientific literature searches. For both purposes, it is important to have a short version of the full story.

Introduction

The central research question and important background information are presented in the introduction. Because science is a process that builds on previous findings, relevant and established scientific knowledge is cited in this section and then listed in the References section at the end of the article. In many articles, a heading is used to set this and subsequent sections apart, but in the woodpecker article the introduction consists of the first three paragraphs, in which the history of the decline of the woodpecker and previous studies are cited. The introduction is intended to lead the reader to understand the authors' hypothesis and means of testing it. In addition, the introduction provides an opportunity for the authors to show that they are aware of the work that scientists have done before them and how their results fit in, explicitly building on existing knowledge.

Materials and Method

In this section, the authors describe the research methods they used .All procedures, equipment, measurement parameters, etc. are described in detail sufficient for another researcher to evaluate and/or reproduce the research. In addition, authors explain the sources of error and procedures employed to reduce and measure the uncertainty in their data . The detail given here allows other scientists to evaluate the quality of the data collected. This section varies dramatically depending on the type of research done. In an experimental study, the experimental set-up and procedure would be described in detail, including the variables, controls, and treatment. The woodpecker study used a descriptive research approach, and the materials and methods section is quite short, including the means by which the bird was initially spotted and later photographed and video-taped.

Results

The data collected during the research are presented in this section, both in written form and using tables, graphs, and figures. In addition, all statistical and data analysis techniques used are presented Importantly, the data should be presented separately from any interpretation by the authors. This separation of data from interpretation serves two purposes: first, it gives other scientists the opportunity to evaluate the quality of the data itself, and second, it allows others to develop their own interpretations of the findings based on their background knowledge and experience. In the woodpecker article, the data consists largely of photographs and videos The authors include both the raw data (the photograph) and their analysis. The sketch of the bird on the right-hand side of the photograph is also a form of analysis, in which the authors have simplified the photograph to highlight the features of interest. Keeping the raw data (in the form of a photograph) facilitated reanalysis by other scientists: in early 2006, a team of researchers led by the American ornithologist David Sibley reanalyzed the photograph in Figure 3 and came to the conclusion that the bird was not an ivory-billed woodpecker after all (**Sibley et al, 2006**).

Discussion and conclusions

In this section, authors present their interpretation of the data, often including a model or idea they feel best explains their results. They also present the strengths and significance of their work. Naturally, this is the most subjective section of a scientific research article as it presents interpretation as opposed to strictly methods and data, but it is not speculation by the authors. Instead, this is where the authors combine their experience, background knowledge, and creativity to explain the data and use it as evidence in their interpretation (see our Data: Analysis and Interpretation module). Often, the discussion section includes several possible explanations or interpretations of the data; the authors may then describe why they support one particular interpretation over the others. This is not just a process of hedging their bets – this how scientists say to their peers that they have done their homework and that there is more than one possible explanation. In the woodpecker article, for example, the authors go to great lengths to describe why they believe the bird they saw is an ivory-billed woodpecker rather than a variant of the

more common pileated woodpecker, knowing that this is a likely potential rebuttal to their initial findings. A final component of the conclusions involves placing the current work back into a larger context by discussing the implications of the work. The authors of the woodpecker article do so by discussing the nature of the woodpecker habitat and how it might be better preserved. In many articles, the results and discussion sections are combined, but regardless, the data is initially presented without interpretation.

References

Scientific progress requires building on existing knowledge, and previous findings are recognized by directly citing them in any new work. The citations are collected in one list, commonly called "References," although the precise format for each journal varies considerably. The reference list may seem like something you don't actually read, but in fact, it can provide a wealth of information about whether the authors are citing the most recent work in their field or whether they are biased in their citations towards certain institutions or authors. In addition, the reference section provides readers of the article with more information about the particular research topic discussed. The reference list for the woodpecker article includes a wide variety of sources that includes books, other journal articles, and personal accounts of bird sightings.

Supporting material

Increasingly, journals make supporting material that does not fit into the article itself like extensive data tables, detailed descriptions of methods, figures, and animations available online. In this case, the video footage shot by the authors is available online, along with several other resources.

Reading the primary literature

The format of a scientific article may seem overly structured compared to many other things you read, but it serves a purpose by providing an archive of scientific research in the primary literature that we can build on. Though isolated examples of that archive go as far back as 600 BCE, the first consistently published scientific journal was the Philosophical Transactions of the Royal Society of London, edited by Henry Oldenburg for the Royal Society beginning in 1666. These early scientific writings include all of the components listed above, but the writing style is surprisingly different than a modern journal article. Learning to read scientific articles is a skill, and like any other skill, it requires practice and experience to master. It is not, however, an impossible task. Strange as it seems, the most efficient way to tackle a new article may be through a piecemeal approach, reading some but not all the sections and not necessarily in their order of appearance. For example, the abstract of an article will summarize its key points, but this section can often be dense and difficult to understand. Sometimes the end of the article may be a better place to start reading. In many cases, authors present a model that fits their data in this last section of the article. The discussion section may emphasize some themes or ideas that tie the story together, giving the reader some foundation for reading the article from the beginning. Even experienced scientists read articles this way – skimming the figures first, perhaps, or reading the discussion and then going back to the results. Often, it

takes a scientist multiple readings to truly understand the authors' work and incorporate it into their personal knowledge base in order to build on that knowledge.

Building knowledge and facilitating discussion

The process of science does not stop with the publication of the results of research in a scientific article. In fact, in some ways, publication is just the beginning. Scientific journals also provide a means for other scientists to respond to the work they publish; like many newspapers and magazines, most scientific journals publish letters from their readers. Unlike the common "Letters to the Editor" of a newspaper, however, the letters in scientific journals are usually critical responses to the authors of a research study in which alternative interpretations are outlined. When such a letter is received by a journal editor, it is typically given to the original authors so that they can respond, and both the letter and response are published together. Nine months after the original publication of the woodpecker article, *Science* published a letter (called a "Comment") from David Sibley and three of his colleagues, who reinterpreted the Fitzpatrick team's data and concluded that the bird in question was a more common pileated woodpecker, not an ivory-billed woodpecker (Sibley et al., 2006). The team from the Cornell lab wrote a response supporting their initial conclusions, and Sibley's team followed that up with a response of their own in 2007 (**Fitzpatrick et al., 2006; Sibley at al., 2007**)). As expected, the research has generated significant scientific controversy and in addition, has captured the attention of the public, spreading the story of the controversy into the popular media.

Conclusion

Science communication plays very vital role in our society. Societal developments are some extent depends on scientific journals, where first hand research result on science and technology are being published. Science communicators use scientific journals and its articles for dissemination scientific information among the academic community for research and development purpose. But its true that the shape scientific journals are being changed as well as our information seeking behavior pattern are also being changed.

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